

the Pterodactyles and Dinosaurs calls for no separate mention, although we are led to wonder why the Crocodiles are so widely separated from these groups.

The whole chapter on birds is decidedly feeble; and we must certainly take exception to the statement that *Hesperornis* and *Ichthyornis* respectively connect *Archæopteryx* with the Ratitæ and Carinatae.

Turning to the last chapters, on the Mammals, we find the author adopting the view that the Monotremes have had an origin totally separate from the other two subclasses. We then have a notice of the Secondary Mammals, in which we observe a lamentable lack of attention to recent work on their affinities, and also to the synonymy of the various genera. We also notice that the Jurassic *Plagiaulax* and its allies are still referred to the Diprotodont Marsupials (p. 327); so that on these points the author's evolutionary views are totally out of date. Following the Marsupials, we have a very fair, although brief, account of the most recent conclusions on Mammalian phylogeny, which needs but few remarks. We notice, however, that the author adopts M. Boule's views as to the dual origin of the *Canidae*, according to which the Foxes (Alopecoids) are considered to have originated from *Cynodictis*, while the Wolves, Jackals, and Dogs (Thooids) trace their descent to *Amphicyon*. To ourselves, indeed, it has always appeared difficult to understand how these two groups of *Canidae* have become so much alike if they had this dual origin; and this difficulty is increased by the author's statement that those Thooids known as *Cyon* differ from the other members of that group in having originated from *Cynodictis*.

On p. 343 the author makes a slip in stating that the Hydracoidea are now represented only by a single genus; while later on he appears to be uncertain whether the Siwalik beds should be regarded as Upper Miocene (pp. 349, 350) or Upper Pliocene (p. 366). Again, we notice on p. 353 some want of acquaintance with the recent literature relating to the ancestry of the horse, *Orohippus* being identified with *Pliolophus*, whereas the latter is really the same as *Hyracotherium*, while the former is identical with *Pachynolophus*. We are in full accord with the author when he states, on p. 361, that *Chalicotherium* (with which the supposed Edentate *Macrotherium* is now known to be identical) is an aberrant Ungulate, although we must be permitted to differ from him when he adds that it shows signs of affinity with the Edentates.

We must likewise take exception to the statement, on p. 370, that the Indian Nilgai is in any sense the progenitor of the Oxen; while the view expressed on the same page, that the Buffaloes, Bisons, and true Oxen have severally originated from three distinct groups of Antelopes, can be only regarded as another instance of the author's partiality for multiple phylogenies. Although M. Priem is careful not to commit himself to the view that the Cetaceans have been derived from the extinct Enaliosaurian reptiles, yet the prominence which he gives to the statement of that view may be taken as a sign that he has not thoroughly purged himself from that heresy.

Finally, although we have felt bound to call attention to a certain amount of imperfection in the later chapters, yet, as a whole, we can conscientiously recommend the

work before us to those readers who are desirous of obtaining in a compact form a summary of the evidence afforded by palæontology of the progressive evolution of animal forms.

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METALLURGY.

Leçons sur les Métaux. Par Prof. Alfred Ditte. (Paris: Dunod, 1891.)

Traité pratique de Chimie Métallurgique. Par le Baron Hans Jüptner von Jonstorff. Translated from the German by M. Ernest Vlasto. (Paris: Gauthier-Villars, 1891.)

THESE two volumes, recently published, are both of unusual interest. The first, by Prof. Ditte, who is well known to English readers by his "Exposé de quelques Propriétés générales des Corps," may be said to mark a new departure in teaching the chemistry of metals. He points out that the principles of thermochemistry do not merely enable reactions to be explained, but to be predicted, and, on the other hand, when two sets of reactions are simultaneously possible, the laws of dissociation render it possible to rigorously define the conditions of equilibrium which are established in the chemical "systems" under consideration. It is often possible, with the guidance afforded by these laws, to say, in the absence of direct experiment, why one reaction is impossible and another certain to occur; or why a certain reaction begins without difficulty, and is arrested at a definite stage; or why a reaction which takes place readily under certain conditions cannot be effected under others that do not appear to differ greatly from those which were favourable to it. As a pupil of Deville, the author might have been expected to develop, in a treatise such as this, the teaching of his great master, and he has admirably performed his task. The classification of the work is excellent, the metals being first considered collectively, and then in detail with numerous tables of the data and constants which are so frequently required by metallurgists.

The work begins with a very clear account of Berthelot's labours in *mécanique chimique*, special care being devoted to the description of the calorimetric investigations, and to the appliances adopted in these important researches.

It appears to be a great advance for us in this country to read a chemical treatise in which the thermal values of the equations are stated in calories, side by side with the formulæ. As the book is too long to review in detail, it may be well to indicate the nature of one section only, as showing the author's care and thoroughness in the selection and arrangement of the materials. Take, for instance, the few pages devoted to carbides. The author points out that carbon in uniting with metals sometimes gives rise to the formation of true compounds, and at others to solutions of carbon in the metal. He then describes the orange-yellow product obtained by the action of carbon on metallic copper, and passes to the association of carbon with nickel, which does not confer upon nickel the property of being hardened by rapid cooling. The definite carbides of manganese, as well as the indefinite associations of carbon with iron and manganese, receive due attention,

and the author proceeds to deal with the carbides of iron, and finally with the well-defined carbides of niobium and tantalum, which have respectively the formulæ Nb_2C_3 and Ta_2C_3 .

A terse description is then given of the work of Troost and Hautefeuille on the heat of formation of carbides of iron and manganese, which led to the conclusion that the union of carbon and iron is attended with absorption of heat, while in the case of the union of carbon and manganese heat is evolved, the evidence leading to the belief that Mn_3C is a true compound possessing considerable stability. The action of heat on carbides is then dealt with, and a brief, but sufficient, reference is made to Forquignon's work on the action at a high temperature of hydrogen on cast-iron. The section concludes with a description of the modes of preparing carbides, and with a sketch of the formation and properties of the nitrocarbides, more especially those of niobium and titanium.

The sections of the work devoted to the consideration of tellurides, arsenides, and antimonides, are equally good. With regard to individual metals, in the portions of the work as yet published, only potassium, rubidium, cæsium, ammonium, thallium, sodium, lithium and the metals of the alkaline earths, barium, strontium, and calcium are dealt with, but sufficient evidence of the merits of the book has been given in this brief review to show that the rest of it will be gladly welcomed, for Prof. Ditte has earned his place among the great metallurgists of France.

We should be grateful for curves indicating the effect of definite elements on the physical constants of metals.

Baron Jonstorff's book is of an entirely different character, though it is not, in its way, less excellent or useful. He says that it issues from an ironworks, and is addressed to practical metallurgists. Its aim is, however, somewhat different from that of most treatises on analytical chemistry, the author's intention being not merely to guide the chemist in his analytical methods, but to enable a blast-furnace manager or an iron-master to realize what kind of services the laboratory can render, what questions relating to the routine of work the analyst can solve, and, above all, in what way the questions should be put.

The author deals with the more important special methods of analysis, and of assaying iron and steel, and he gives due attention to the examination of refractory materials—slags, fuel, and gaseous products—and his method is singularly clear and precise. An appendix gives tabular statements which will be useful in daily work.

The book, as a whole, shows incidentally the great difference between the works-laboratory of the present day and that of twenty years ago. There is still much room for improvement, no doubt, but the laboratory of an ironworks has, in many cases, ceased to be little better than a shed, erected, say, behind the boiler-house, with an analyst and a few boys as the scientific staff.

Those who have visited the author in his beautifully situated Styrian works, and have seen his manipulation, as the reviewer has, will appreciate the excellence of his labours, and will be glad that a good translation into French will make their results more generally known.

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BACTERIA AND THEIR PRODUCTS.

Bacteria and their Products. By Sims Woodhead, M.D. Published in the "Contemporary Science Series." (London: Walter Scott, 1891.)

SCARCELY a year passes in England, France, or in Germany, without the publication of one or more treatises on the fascinating subject of bacteriology. Many of the more recent of these works have been written for the general reader rather than for the student, and have shown a considerable want of accuracy and lucidity, a circumstance which can only be accounted for by the fact that accomplished bacteriologists have not been their authors.

We have now before us "Bacteria and their Products," a work which we might infer from a glance at the cover, and general arrangement, to be certainly intended for the general reader. This view is strengthened by the several object-lessons and homely similes scattered throughout the text, with the fitness of which we totally disagree; witness, for example, the extraordinary comparison of a nodule of *Actinomyces* with two daisy heads placed base to base, "the sterile flowers in the centre" then corresponding to the club-shaped rays. The comparison is bad, but the botany is worse. Then there is the not very abstruse mathematical problem on p. 24, and the guide-like description of the Pasteur Institute, all intended, we must conclude, for the general reader rather than for the student.

On the other hand, there is a very large collection of facts, much information about fermentation and chemistry (although the interesting and oft-quoted experiments of Raulin are omitted), numerous references, and a very plentiful supply of formulæ, the whole requiring, in order to understand and appreciate them, a reader equipped with a thorough knowledge of the sciences bearing on the subject.

Putting this question aside, however, we candidly confess that we do not admire the style or arrangement of the book. There is a conspicuous want of lucidity, and of that accuracy of observation which one would have expected of the author. For instance, "What are Bacteria?" is the question propounded in chapter ii.; but the answer to this key-stone question is left in much doubt, as the description of the protoplasm, cell membrane, mode of division and reproduction of the "specks," is exceedingly confused. We should not choose Gram's method to demonstrate the capsules of *Actinomyces*, nor, indeed, any other capsules; and we have reason to doubt, after the beautiful monograph on *Cladotrix* by Billet, that the brown colour of that organism is due to iron. Again, what does the author mean when, speaking of cilia, he says, they "appear to develop only in those organisms that have special affinity for oxygen, for, as soon as the ciliated forms reach the surface of a fluid, they lose their cilia or they become much less active," &c.? Tables of classification are heaped in with scarcely any attempt to sift and reduce them to a form compatible with the scope of the book. Is this done because, as the author says (p. 47), "to the pathologist, however, these classifications are of comparatively little value"? We maintain that for a work of this kind the author has no right to take a one-sided view, and that to the science of